# INDUSTRIAL STANDARDIZATION

Formerly ASA BULLETIN



## A MONTHLY REVIEW

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*The American Standards Association is organized to provide systematic means of cooperation in establishing American Standards to the end that duplication of work and the promulgation of conflicting standards may be avoided; to serve as a clearing house for information on standardization work in the United States and foreign countries; to act as the authoritative American channel in international cooperation in standardization work*

# Technique of Size Control in Precision Grinding Operations[1]

*by*

R. E. W. Harrison[2]

*A survey of factors of operation control and design affecting the accuracy of grinding machine operations; methods of accuracy control*

*Because of the importance of this paper in connection with interchangeable manufacture, and its close connection with two of the most important projects now going forward under ASA procedure—gaging and surface finishes—it is presented in full in* INDUSTRIAL STANDARDIZATION. *The length of the paper makes it necessary to print it in two sections, the second of which will appear in the January, 1933, issue.*

## I

## Operation Control

### *Limit system—key to cheap manufacture*

An observer with an analytical turn of mind, when casting around for those factors which are common to the more successful manufacturing concerns, is immediately struck by the fact that they have one major characteristic in common, this being an enthusiastic and energetic use of the limit system of manufacture.

With our undoubted ability to look backwards with great wisdom, we might say that the use of the limit system was inevitable. However, this theory is hardly borne out by the fact that even in this enlightened day and age it sometimes happens that firms will swing into a manufacturing program involving the expenditure of many millions of dollars without first thoroughly investigating the application of a limit system, which would provide the key to cheap and efficient manufacturing.

Despite the fact that the most consistently successful manufacturing concerns exhibit a faithful adherence to the limit system of manufacture, some of the major industries today are operating without such a system, and therefore without predetermined limits to their dimensional specifications. Under the pressure of industrial economics and the competition between industries, these loose practices have been gradually disappearing, but the process is a slow and costly one, and the wear and tear directly measurable in the loss of revenue to the stockholders of these backward institutions.

When considering manufacturing conditions, it has become customary, when looking for the proof of a statement which in itself is axiomatic, to quote the automotive industry, and the author feels that no excuse is necessary, when pointing to the very successful exploitation of the limit system of manufacture which has been carried out by the larger automobile manufacturing concerns. In fact, it might truthfully be said that the extraordinary phenomenon which we have just witnessed, *i.e.*, the placing on the market of a 65 hp eight-cylinder car at $460 has only been made a commercial possibility by an extremely efficient system of manufacture, whereby all the components which make up this remarkable eight-cylinder automobile, are produced within fine limits of accuracy, which in turn permit the manufacturer to assemble these parts without hand correction of machining errors.

It soon becomes apparent that the system of manufacturing to limits is basic, inasmuch as, when fitting component parts together it automatically insures absence from interference and freedom from undue looseness.

### *Widest possible limits a necessity*

Much progress has been made during recent years in the manufacture of machine tools capable of producing work to finer degrees of accuracy. It will be appreciated as logical that the work produced on any machine tool can be no more accurate than the machine tool itself, hence the very obvious responsibility of the machine tool manufacturer to produce machines with the minimum deviation from the zero limit.

Coupled with this, there is the necessity for capacity in the machine tool to duplicate these results con-

[1] Paper presented before the National Machine Shop Practice Meeting of the American Society of Mechanical Engineers in Buffalo, October 3, 1932.

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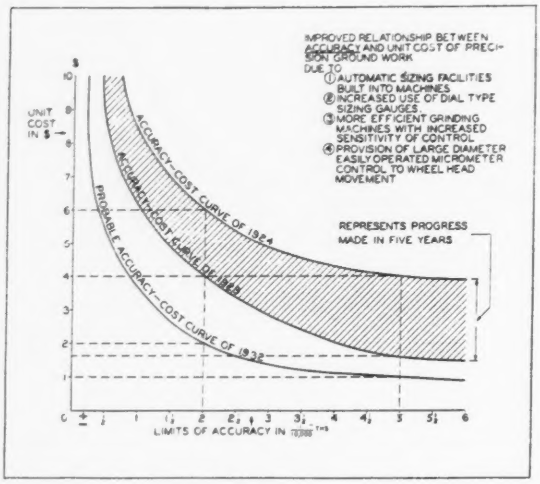


FIG. 1

*Accuracy—cost diagram*

sistently over a long period of time. The machine which will produce a good job today within close limits of accuracy and a poor job tomorrow has no place in industry, the resulting variation in sizes causing a manufacturing confusion, even more costly than that which obtains in those cases where there is no system at all.

To insure cheap manufacture, tolerances should always be at the maximum permissible, consistent with the correct functioning of the piece of work under consideration. It is true that there will always be a certain amount of wear to contend with, and this must invariably be taken into account when fixing the tolerances. However, every piece of equipment has a certain projected economic life, and it is a futile waste of money to build something into this piece of equipment in the way of accuracy, durability, or functions of any kind designed to endure for a long period of time after the economic life of the equipment has been expended.

As will be gathered from reference to Figure 1, a graphical representation of the cost of manufacture within certain prescribed limits, it is an extremely costly matter to attempt to produce work which approximates perfection. Actually there is no such thing as perfection in this world, so the graph has been arranged to indicate that perfection can only be attained at infinite cost and is, therefore, something which represents an unattainable ideal, but nevertheless a focal point in our observations.

Control over the limits of accuracy must be paid for in a proportionate way, not only in the time of the workmen, but in the capital investment in the machine, the gaging equipment, the type of factory in which the equipment is housed, the engineering, the supervision, and, in fact, every factor which goes to make up the manufacturing cost. Hence, any well-balanced manufacturing scheme should be predicated on the idea that in no single instance will a limit of accuracy be prescribed for any particular piece which is finer than that piece need have to fulfill its functions satisfactorily and to last the anticipated economic life.

### *The precision grinding machine*

The advent of the precision grinding machine about 50 years ago provided manufacturing industry with a tool very far-reaching in its effects. The introduction of the lathe, the planing machine, the milling machine, and the drilling machine, while representing milestones in the path of progress, and the basis on which manufacturing procedure has been built up, are relatively of secondary importance to the precision grinding machine, which gives the manufacturer a quick and easily controlled method of securing not only accurate size control, but also finish which controls initial wear on both hard and soft materials.

It might be said that the precision grinding machine in conjunction with the automatic lathe, has made mass production an economically and commercially attractive means of employing capital. While those who are analytically minded might say that we could have continued to live and, in a measure, progress without efficient grinding machines, it is equally true that life would have lacked many of the refinements which we now consider necessities. In fact, almost every article of daily usage which we now consider a necessity, is influenced at some stage of its manufacture by the precision grinding machine, and it is doubtful if any one factor so affects the final cost of the article as the ease with which accurate size and good finish have been attained, and in every case this is attributable to the influence of the precision grinding machine.

It might be said, therefore, that the precision grinding machine in its various forms, is the sizing tool of industry, permitting us to manufacture within close limits of accuracy to degrees of finish which limit wear and, therefore, impart to the piece an economic life consistent with the capital value involved.

### *Finish and initial wear*

Closely coupled with the problem of manufacturing accuracy is the control of the finish of the piece as it leaves the grinding machine. It has been definitely proved that according to the roughness or smoothness of the finish involved, so is the extent of

the inevitable initial wear. Reference to Figure 2 will clearly indicate that there is a quite appreciable margin of wear on even a smoothly ground surface, and it is necessary, if correct functioning is to be obtained over the maximum period of time, that this initial wear be taken into account when fixing the limits of accuracy to which the piece should be manufactured.

For instance, referring to Figure 3, a running fit on a shaft which normally would have .0035 in. clearance between the maximum diameter of the shaft and the minimum diameter of the hole, would be automatically opened out to, say, .015 in. of maximum clearance after running in, if the shaft or the bore on both be ground roughly. In some classes of mechanism such clearance would be fatal to correct functioning.

It has been realized by those in control of the most precise manufacturing schemes that it is futile to specify close limits of accuracy on parts which are finished with a rough surface, inasmuch as the initial wear will take the dimensions of the piece out of the prescribed tolerance area. To quote an example, it would be extremely irrational to make a 1 in. plug gage with, say, a No. 3 finish, as it is obvious that this plug gage could not retain its size and, therefore, its ability to gage correctly beyond, say, the first few hours usage.

To quote another example, we have the modern automobile. In the cheaper classes of cars it is customary to caution the driver of a new car not to exceed a speed of 30 miles per hour for the first 500 miles. Such precaution is not necessary with most higher priced cars. The difference between the two automobiles is that in the cheaper the finishes are relatively rougher and any undue pressure or load applied to them will cause a ragging of the surfaces which will lead to permanent injury. The higher priced car with its more refined finishes, presents no such danger, hence, there is not the same necessity for speed restriction when putting the car to work.

Another significant factor is that the makers of all automobiles in all price schedules now fit oil filters, and while this filter may function as a cleaner for the removal of carbon and other impurities, its main function when the car is new is to safeguard the life of the wearing members of the engine against the results of initial wear, *i.e.,* the removal of the surface fuzz of steel, or iron, or white metal, or bronze, or whatever the material may be which is removed during the running-in period, and circulated through the oil stream.

Those who have had the experience of dismantling an old car which has received plenty of clean oil and careful usage, will have noted that the finish on the

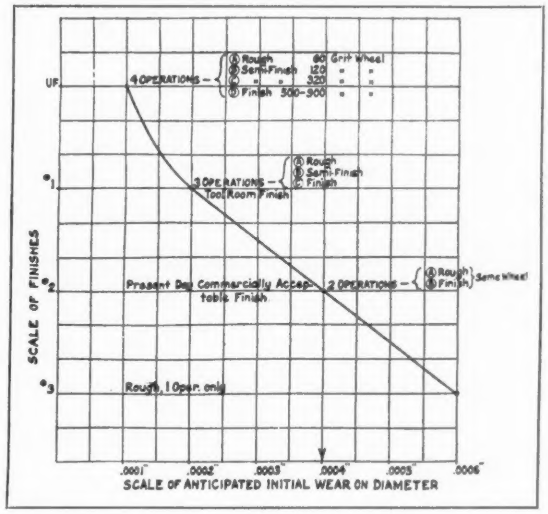


FIG. 2

*Relation between finish and potential wear*

crank pins and journals is smooth and silvery, in other words the initial wear has taken place without disruption to the basic surface. Observations over a long period of time indicate that when once the initial wear has been taken care of properly, the subsequent wear is slow and in fact almost negligible.

From the foregoing remarks, therefore, it will be obvious that in those mechanisms where accuracy within fine limits is a necessity, with this also goes the responsibility for producing those surfaces to an extremely fine finish, thereby limiting the initial wear and conserving the original limits of accuracy.

### *Overburdening the grinding machine*

Many of the characteristics which obtain in engineering are repeated in other walks of life, and it is as true in an engineering sense as in any other, that it is the willing horse which is overburdened. In this particular case we have under consideration the precision grinding machine and its ability to produce work to within close limits of size, quickly and cheaply. This has led to the overburdening of this tool by the indiscriminate loading up of stock removal, eccentricities, and other inaccuracies. It is assumed by those who do not know that the grinding machine will remove these most economically, and that the cost of production will still be low. No greater fallacy exists. The grinding machine is a metal removal tool, capable of removing metal at a certain maximum definite specified rate. There is a definite relationship between the horsepower of the machine and the rate of metal removal, and there is a definite relation between the speed at which accu-

rate sizing can be accomplished and the accuracy of the work after the sizing operation.

In other words, in both internal and external operations, eccentricity must first be removed before sizing accuracy can be imparted. Also, lack of parallelism, chatter marks, and other imperfections must first be removed before an attempt is made to secure an accurate dimension on a given diameter.

*Internal grinding*—In the case of the internal grinding machine with the grinding wheel carried on the end of a relatively small diameter spindle, often greatly overhung, and necessarily operated in a condition and a place where the maximum rigidity is difficult to attain, the previous inaccuracies of the work prior to grinding exercise a tremendous influence over the amount of time taken to secure accuracy in size, concentricity, finish, parallelism, and freedom from periodic errors.

A nice balance must be maintained between the accuracies demanded from the operations preceding grinding and the grinding operation. Sometimes this is the cause of departmental disputes. However, this matter should never be permitted to become the subject of even departmental discussion. The Work Processing Department should invariably set down the limits of accuracy for each operation, not only for the grinding, but else for the turning, the boring, the milling, and in fact for the surfacing of any portion of the piece during the operations immediately preceding grinding. In many cases it is desirable, and, in fact, economically necessary to specify limits of distortion to which the piece is permitted to go during heat treatment, as it is quite conceivable that careless or ultra rapid heat treatment, while being cheap in itself, can inject a production cost increase into the grinding operation out of all proportion to the saving effected by the speed of heat treatment or other operation, and, in fact, this one factor alone can jeopardize the efficiency of the whole manufacturing problem.

It therefore follows that in any well balanced manufacturing scheme the Work Processing Department must set up limits of accuracy and deformation for all operations preceding grinding, and this is particularly true in regard to internal grinding where the ability of the machine to remove imperfections at a fast rate is low, and the correction can only be obtained at the expense of time, due to the necessarily light characteristics of the spindle construction which are common to all such grinding machines.

*External grinding*—In the case of external grind-

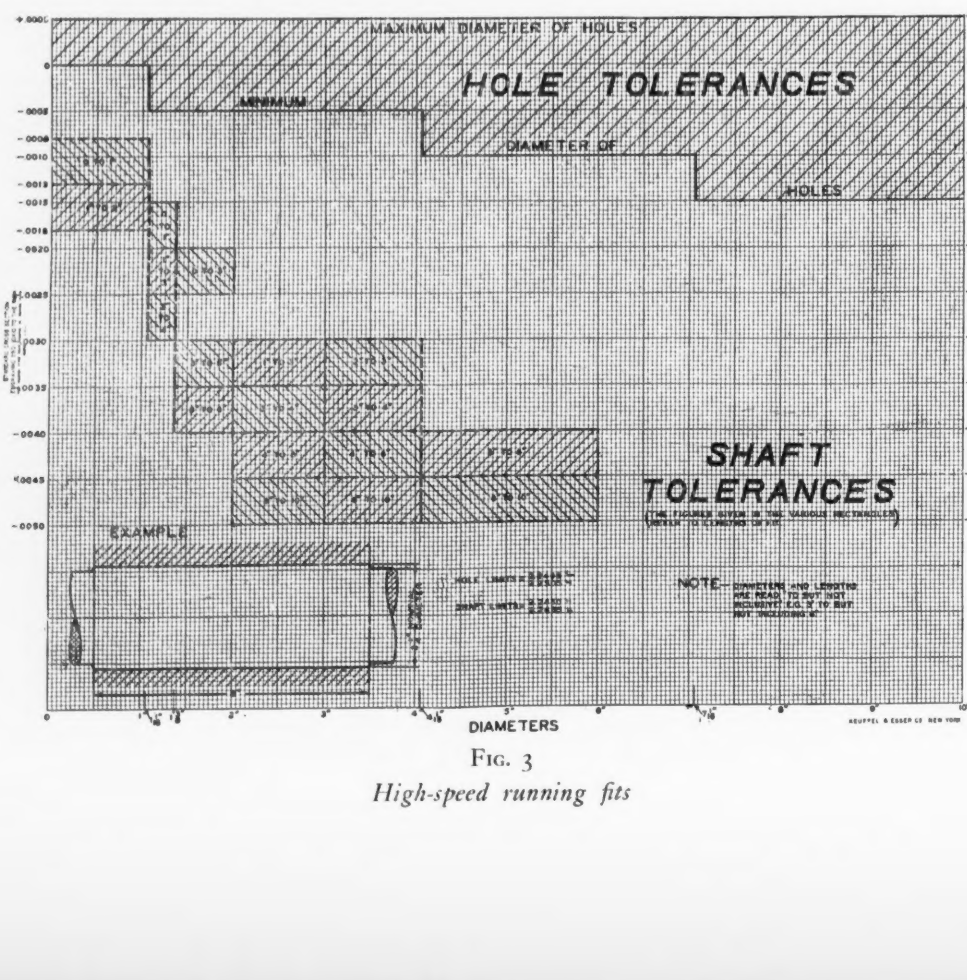


FIG. 3

*High-speed running fits*

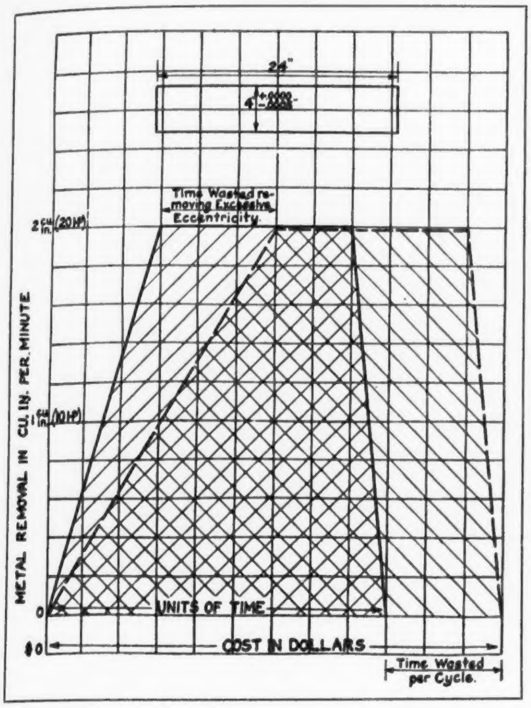


FIG. 4

*Relation between cost (based on time) and metal removal*

ing, as in that of internal grinding, the increased use of automatic grinding machines has brought to light many factors affecting production, which hitherto had not been given that degree of consideration which their importance deserves.

Automatic grinding machine operations entail a consistency in preceding conditions far in excess of that required for individual or manual production, and this condition has thrown a searchlight onto such factors as excessive stock, variation in stock, lack of parallelism, eccentricity, faulty centering, excessive burrs, lack of consistency in the metallurgical make up of the material, and a host of other minor things, all of which exact their toll from the possible profit in the grinding operation. In the case of external grinding, as in internal grinding, there is a definite responsibility on the processing department to specify the limits of accuracy to which the work should be turned, bored, and centered prior to the grinding operation. The practice of making inspections between operations is as good today as when it was first inaugurated. It pays dividends, obviates departmental disputes, and above all it results in the allocation of a fair amount of burden to all machines involved in the manufacturing scheme.

The diagram, Figure 4, clearly illustrates the cost in dollar units of lack of attention to the details which have been mentioned above.

*Surface grinding*—There has been a phenomenal growth in the application of surface grinding during the last fifteen years, and while this has entailed closer attention to details on the part of the foundry, the practice has been found economical and the results satisfactory.

The one factor which, on occasion, most adversely affects the economics of cheap surface grinding is the wide variation in the thickness of the pieces presented to the grinding wheel. Particularly is this true in the case of horizontal and vertical spindle surface grinding operations of the type carried out on the Diamond, Bridgeport, and surface grinders, where work is bulky and much time is lost when it is necessary to short-stroke the machine or rotate the chuck while one piece only is being ground.

It is as true of the grinding machine as any other machine tool that the tool is only a productive unit when the cutting element is buried in the work. Variation in the amount of stock involves free traversing or cutting air rather than metal, and this is costly and wasteful.

In this case also, the matter must be taken care of by the Work Processing Department and definite limits set which will insure that, while not imposing too heavy a burden on the foundry or machine shop, the stock for removal by the surface grinding machine is not excessive in regard to amount or variety.

Summarizing the above discussion of internal, external, and surface grinding, therefore, it will be agreed that, to secure the lowest cost, considerable judgment on the part of the processing management is necessary to insure that the over-all costs of production are made up of proportionately divided departmental responsibilities.

### *Underburdening the grinding machine*

Just as in the case of operations as cited above, it is as economically unsound to ***underburden*** the grinding machine with responsibility for correct sizing, thereby throwing the production scheme out of balance by demanding an accuracy from the previous operations in excess of that which the particular machine tool involved will normally produce when fully loaded.

While it is true that excessive accuracy demands upon the grinding machine will increase production costs, it is equally true, and even more apparent, that excessive accuracy demands on drilling machines, boring machines, lathes, milling machines, and gear cutters, will boost the cost of items produced on these machines beyond the economic limit.

Here again there is necessity for good judgment and production balance on the part of the production engineering department. This responsibility, however, does not end with this department, but goes right back to the engineering department and chief engineer, and carries the implication that the engineers assigning the limits of accuracy to which parts must be manufactured should be familiar with the possibilities of the machine tools on which these parts are to be made.

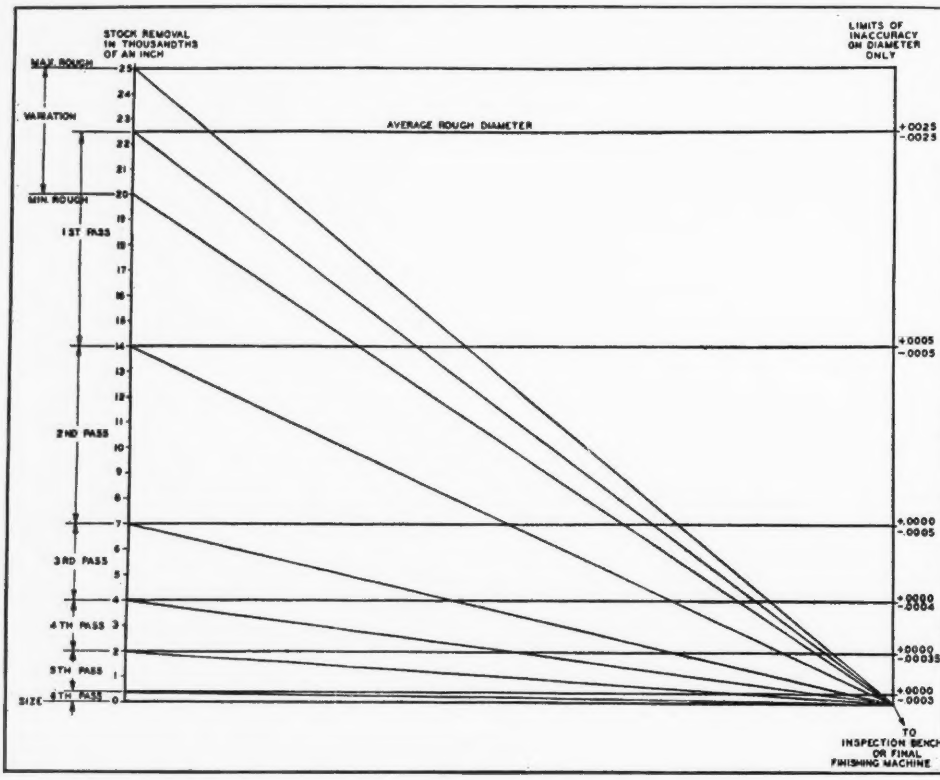


FIG. 5

*Piston pin prepared for final finishing on Cincinnati ultra finish machine or on the Bethel player lapping machine*

It is an unfortunate fact that some designing engineers are not accurately informed regarding the accuracy, and producing possibilities, of modern machine tools, hence the frequent assignment of limits which, if adhered to, would inflate the costs, and the frequent result that limits are taken by the shops as a guide only and ignored, with consequent increase in the cost of assembly and occasionally faulty functioning. The difficulty is especially pronounced in those cases where the very nature of the product is such that components have to be replaced fairly frequently, and it is not unknown for manufacturing concerns actually to be driven out of business by the excessive costs of installing and maintaining repairs once the original installation has been sold and put to work. Nothing can emphasize more clearly the need for a sane and accurate control over the limits of accuracy to which the component parts of a mechanism are to be made.

The design angle on this problem is of paramount importance. To quote an example, within the last few years an article of general household use was designed with over 20 component parts calling for limits of accuracy within a total tolerance of two-tenths of one-thousandth of an inch. The experimental models were made in a tool room where no accurate record of the costs was obtained, furthermore, there was undue optimism regarding the capabilities of machine-tool equipment to produce the components rapidly to the prescribed limits of accuracy and at a low cost. This optimism was based on inexperience and lack of knowledge, also a lack of investigation. The consequence was that a corporation of many million dollars capitalization was floated on the assumption that this article of general use could be put on the market at a low competitive fig-

ure. Several million dollars worth of machine-tool equipment was bought and the whole scheme of production put into motion. A vast quantity of work was put into progress, but when it was in its final stages of manufacture, the real difficulties began.

As is usual in a manufacturing scheme of this kind, the Inspection Department reported direct to the management and the inspectors demanded from the production lines limits of accuracy in accordance with the figures set down by the Engineering Department. The whole scheme reached deadlock conditions and the tangle was eventually only solved by a redesign of the major units, whereby proper functioning was obtained with two parts only made to the fine tolerances and the remainder of the parts to commercial limits with a total tolerance of .0005 in. on each piece.

Generally speaking, engineers can be hired capable of designing mechanisms which will perform any reasonable function under almost any condition, but the real engineer is the man who can design equipment which will achieve the desired results with the minimum number of parts, made to maximum tolerances.

The article referred to in the foregoing paragraphs is now on the market, performing satisfactorily, and yielding a profit to the capital interests at the back of it. However, these people have had to write off many hundreds of thousands of dollars which they can directly charge to lack of engineering experience, and lack of appreciation of the costs of manufacturing to within close tolerances.

*Accurate sizing a building-up process*

With the advent of the centerless grinder in the cylindrical grinding field, a new technique as regards sizing as a part of the mass production program has grown up.

To quote an example, take the automobile wrist pin, an article usually ranging up to 1 in. in diameter by approximately 3 in. long, and produced to limits of accuracy of plus 0 minus .0002. The process by which the extreme accuracy of this component is built up is clearly illustrated in diagrammatic form in Figure 5.

The characteristics of this operation as brought out in the diagram are a gradual decrease in the inaccuracies of the work. Concurrent with this is the building up of the finish until we reach the point where the work has reached its nominal size within a prescribed tolerance and the results obtained are so uniform that inspection is greatly simplified and the hazard of rejection almost eliminated.

The grinding of work such as electric motor armature shafts when handled on center type grinding machines presents a somewhat similar problem but of somewhat greater complication, inasmuch as varying degrees of accuracy are required on the different portions of the shaft. Dependent on the quantities involved and the capital expenditure which each job will stand, the method of sizing and gaging must be evolved.

*(The concluding section of this paper will be published in the next issue of* INDUSTRIAL STANDARDIZATION.)

# Periodic Surveys Keep Standards Up to Date

*The following article is reprinted from "Machinery", London:*

Most engineering firms today have a standardization system for the various machine details used in their products, the object being to enable the designer to refer to a list of, say, standard levers, and select one suitable for the particular job in hand, the advantage claimed for this procedure being that patterns for castings are kept to a minimum and, if parts are made in quantities and kept in stock, there is a reduction in the cost of the part.

A few firms have a department, or one or two men, whose sole duty is to draw up standards and to see that the standards are used. This is good practice and should show good returns. Other firms in slack periods employ the draughtsmen, who would otherwise be idle, on this standardization.

Some firms claim that standardization of machine parts (except, say, bolts and nuts) is not good procedure, claiming that design and styles of design are constantly changing, and that, therefore, standardized parts will not be of the most recent design. This, indeed, is the trouble with standardization, unless some scheme is employed that will insure standards being kept up to date.

Only quite recently the writer came across an amusing case of standardization badly applied. A firm employing two men on no other work but standardization turned up, at the writer's request, their sheets of standard levers and handles. The sheets were about 50 years old, and the designs equally so.

And yet the firm was not employing the levers and handles standardized. Inquiry elicited the reply that the draughtsmen would turn up the sheet of standard handles but, finding them obviously out of date, would not employ a standard but would design a new one for the particular job in hand.

The two men employed on standardization could not design the handles, for their instructions were to standardize details not already standardized; consequently, the result was farcical.

A standard in machine details or general construction should be progressive, not ultimate. A standard can be accepted at any time that the need arises, without waiting for a complete crystallization of design, but should be amended or altered with progress in ideas and methods.

Guards and covers years ago were made from castings, trimmed, and then filled and painted. When machining was an expensive process, requiring as it did highly skilled expensive labor, this was the best way of making covers, but today when welding is so much used the better design is often one involving the making of the covers from sheet metal with the aid of the welding plant. Even when made from cast iron it is often cheaper to machine them all over, thus eliminating trimming and filling. Plated handles are replacing plain machined or cast ones, and so with all details, standards must be brought up to date to conform with modern conditions and practice.

The way to insure this continual progress is to make a constant periodic survey of all standards, altering those that are found to be out of date. A standard should not hamper or prevent progress, but on the contrary should be a stable foundation for further advancement.

# Need Executives' Cooperation in Making Standards

*The following editorial is reprinted from "Product Engineering," April, 1932:*

As the number of commercial materials and products increases there is a constantly growing need for standardization of details, not only to make the processes of production more simple, but also to cut down the confusion and expense when replacements are necessary. Engineers are fully aware of this need but they must act to convince the executives of its importance. Why is it that with so many "standards" already in existence so few of them are in widespread use?

One reason is that an engineering employee who has little executive standing may be assigned to the standards committee. He works with the representatives of other manufacturers who are in the same position as himself. When the standards are arranged by such a committee they are not considered highly important, and they are held up by the executive, or changes are insisted upon to make them accord with his company's products. The result is that they are merely compromises—not the best for the purpose, and not accepted.

All the blame, however, should not be placed on the executives. Perhaps a good share of it should be laid to the procedure of the engineers. A possible solution would be: (1) To insist on responsible executive engineers on the committees; (2) to curtail petty discussions so that higher executives will not lose interest and acquire contempt for the decisions; and (3) instead of shelving or burying the standards in voluminous reports, to bring the decisions forcibly to the attention of executives for action.

# National Testing Association Proposed for Great Britain

Interest in Great Britain has been recently aroused by active efforts to set up a testing association to determine the quality of materials intended to comply with specifications of the British Standards Institution. It is intended that this movement should be instituted by industry itself and that the functions should be supplementary to those of BSI. Under the present British regulations, makers of materials and manufacturers are granted, on request, permission to put the BSI mark on their products if the Institution has specified that the means employed for examination and test, either in the manufacturer's plant or elsewhere, are adequate and satisfactory. The latest proposal goes further in that it is intended that certification by an independent body is to be used as an added endorsement to the claims of manufacturers.

# German Standard on Underground Installations

One of the most important of the recent German national standards deals with the arrangement of gas, water, electricity, and other lines underground in streets.

The first part of the standard deals with the planned arrangement of pipes and cables under streets. It provides that main lines shall in most cases be under the roadways and the supply lines to buildings under the sidewalks. Distances are measured from the street line and the exact location

and depth of various types of lines are specified.

The types to be placed under sidewalks are: postal tubes; cables for fire and police department use; gas pipes for house supply; electric lines for house supply and their supply cable; water pipes for house supply; cables to feed street car lines and for street lighting, which are to be linked up with feed lines for house supply with the car feed lines running along against the curbstones.

The types to be placed under the roadways are: main water pipes, sewers, etc. (not to be laid under car lines); long distance gas pipes; street car line installations (special regulations for these are contained in another document on traffic regulation). Tanks are permitted on private ground only. The distance from the curb is specified for installations on streets such as street car poles, street lamps, and hydrants.

Planting of trees is usually permitted only where the sidewalk is over six meters wide, and they must be planted one meter from the curbstone.

The second part of the standard deals with the treatment of pipe lines and car tracks on streets. The principle is established that all lines, tracks, trees, etc. must be recognized as having equal rights in the street, and must enjoy like protection.

If original plans of installations, or information regarding them are not available, the authorities may make test cuts in the streets to see whether the space desired for work is free. No changes of position may be made without permission of the authorities.

To facilitate matters, it is recommended that every year in the month of December or January a conference of all interests be called by the authorities to discuss plans for the coming year for new construction and to lay out a program for the work.

The principle that no work on public property may be undertaken without permission having been obtained in advance stands except in cases of danger, such as a broken pipe or cable. In such cases the authorities are to be informed by telephone and permission is to be obtained as soon as possible.

Work is done by men in the employ of the special interest concerned, but the repaving of the street shall be done by the city authorities by agreement with those concerned. In cases of big undertakings, the city building authorities may supervise the work at the expense of the builder.

In the setting up of building plans, tests may be made of the proposed arrangements for pipes, cables, sewers, in cooperation with the authorities.

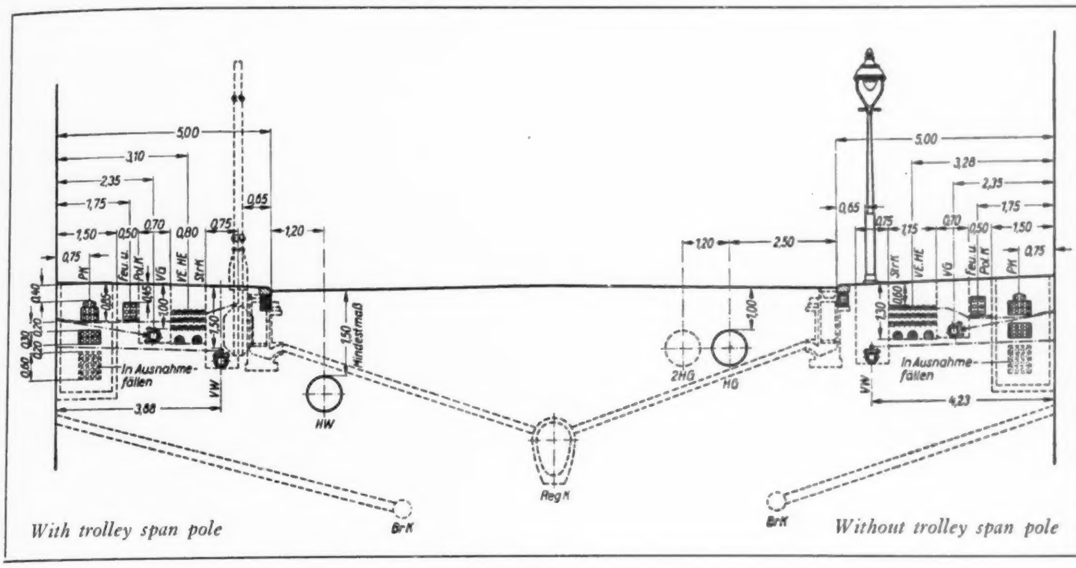


FIG. 1

*Diagram showing German standard for arrangement of street installations. Dimensions are indicated in meters.*

PK—Postal tubes
Feu. u. Pol. K.—Fire and police communication lines
VG—Gas distribution lines
VE.HE.—Electric lines
Str. K.—Electric lines for trolley lines and street lighting

VW—Water distribution lines
HW—Water mains
HG—Gas mains
Br. K.—Sewers
Reg. K.—Storm water sewers

# Planning Standardized Components to Secure Variety in Products

*by*

T. N. Whitehead[1]

*A discussion of progressive component design aimed to secure variety in assembled product with a maximum of standardization of parts*

*The following article is reprinted from the Harvard Business Review of April, 1932. A few brief sections have been omitted because of the limitations of space.*

In America at this moment there are in existence more than 20,000,000 automobiles, while the number of different models is comparatively very small, but is it really the case that amongst millions of car owners the variety of real requirements is so very limited? . . .

Two questions arise: Is it possible to retain the advantages of economical production whilst obtaining the benefits of a greater variety? And is the problem of immediate importance to business anyhow?

I shall try to show that the answer is "Yes" in both cases, and that one solution at least lies with the planners of products. Take the second point first: what sort of behavior might be expected in a society of which the members are starved of opportunities to express their individuality in the choice and arrangement of commodities? Surely the probable result would be twofold: first, an increased emphasis on individuality of conduct in other directions and, second, an instability of demand for commodities leading to a thirst for mere novelty (as distinct from improvement). . . .

To anyone who has lived both in Europe and in America, a very interesting contrast in the commodity environment presents itself. In Europe what impresses the buyer is the variety of styles carried by the shops; on the other hand, the change from one year to the next is comparatively small, nor is change always appreciated by the customers who, over a large range of purchases, are distinctly conservative in their demands. This condition is not favorable to rapid progress and naturally tends to result in the continued manufacture of obsolete designs, and possibly by obsolete methods. By comparison, the variety to be found in American shops seems rather meager; on the other hand, the rate of change in design in America is far more favorable to progressive improvement, and this seems to be appreciated by the buying public.

A careful observation of the "novelty" features of consumers' commodities reveals two rather different reasons for their introduction: first, that the novel feature is a definite improvement—this is the explanation always given by the sales organizations, but often this statement is at best questionable; the second reason seems to be that novelty, as such, is attractive to the customer. This might be explained as a belief (true or false) that novelty implies progress, but I think that this is poor psychology; the fact is that customers are attracted by novelty for its own sake and even as an instinctive compensation for the lack of variety. If novelty were a true compensation for variety, all might be well; but the fact that the range of wallpapers is different this year, as contrasted with last year, and will change again next year, does nothing to help me find what I want *now*. Consequently, I buy something I do not quite like; I find it on many of my friends' walls (which further diminishes my sense of individual expression), and I am vaguely restless and snatch at novelty, *not* because the novelty fits my needs, but largely because it is novel.

The result of all this is that, since the desire for a novelty is not based on a rational fitting of specific needs, this desire becomes aimless or capricious; it is, in fact, incalculable and subject to the chance of suggestion. Here results a curious paradox; for want of a better guide, the customers' choice amongst novelties is guided by suggestion and so takes on the character of a mass, or herd, movement. Everybody tends to choose the same style, and individual expression is still further balked; thus is formed a vicious circle, in which a lack of variety tends to perpetuate itself, inducing an unnecessary tendency to act together and so further reduce variety, coupled with an increase in the capriciousness of future demands.

The growing importance of advertising is a rele-

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vant consideration here. This is immediately important to manufacturers who complain of just these very characteristics: desire for novelty as such, coupled with no rational basis that can assist a prediction as to *what* novelty will prove a good seller. The fact that this is the logical outcome of restricting variety *at a given moment* is not sufficiently recognized; the attempt to do this has resulted in forcing the manufacturer to provide novelty (*i.e.*, variety *through time*) at a rate greater than is justified, either by the manufacturing organization or by the evolution of genuine improvement in design, and encourages that worst bugbear of all, capriciousness of future demand.

Here, perhaps, it should be remarked that I am referring to the variety available to people of moderate income; the fact that almost anything is available anywhere at a price does not help to solve a widespread social problem.

What is evidently required is some manufacturing organization which will permit of the economical production of a greater variety of commodities, coupled with a sufficient flexibility to enable a reasonable degree of change following progress in design. This would steady demand by giving it a rational basis for choice and at the same time broaden the variety demanded, thus diminishing the "hit or miss" character of future demand.

### *The importance of component design*

This desirable result can be at least partly achieved by the rational development of *component design*.

To begin with a simple illustration, which will show the essential characteristics of component design: compare the radiators of automobiles with those by which we heat our homes. The essential element of an automobile radiator is commonly built up into one piece; it can neither be enlarged nor changed in any way without actually cutting metal; moreover, if the manufacturer wishes to change the radiator in future models, he is compelled to cut his metals to new shapes (or, of course, cast, mold, etc.). This might be called the *unit design* of radiators. The heating radiator of our homes is designed in another way, for, as can be easily seen, the radiator as a whole is assembled by bolting together a number of separate parts, or components, each of which is a unit in itself. Hence, though the unit cannot be subsequently modified without actually cutting metal, the size of the complete radiator can be changed by merely rearranging the component parts. Thus, alternative house radiators can be constructed by assembling varying numbers of standard units, and no alterations in the size and shape of any one piece of matter are involved. This is an example of component design.

Component design does not always lead to such flexibility in the end product; for instance, the engine of an automobile can be taken apart or assembled with the help of a wrench and a screw driver, and such an engine is an assembly of components; this renders possible replacements without modifying the size and shape of any single piece of matter; but it does not enable the engine to be itself varied in design, *e.g.*, doubled in power by the addition of more units.

Component design may have a number of other characteristics, and to appreciate these we must consider the possible ways of organizing components to form end products. The assembly of units may be "simple" or "progressive." The house radiator is an example of a "simple" assembly in which a number of elementary parts—*i.e.*, several similar castings, two or more long bolts, nuts and washers, etc.—are placed in a relative position with respect to one another.

An automobile gives an example of progressive assembly, a typical arrangement being roughly as follows: the complete vehicle is assembled from such components as a body, a chassis, a battery, gas, oil, water, grease. Some of these components have previously been assembled from subcomponents; thus, the chassis was built by placing in their relative positions an engine, a frame, springs, two axles, steering gear, etc. These subcomponents were similarly assembled from lesser components; the rear axle, for instance, from castings, turned shafts, ball or roller bearings, etc. The roller bearings are assemblies of rollers, races, and possibly cages.

Here we have a hierarchy; components of the first order (that is, single pieces of metal) are assembled into second-order components, these assembled into third-order components, and so on, until the final end product is reached. The real picture is, of course, more complicated; thus, perhaps a second- and a fourth-order component may be assembled together with first-order components (*e.g.*, bolts and nuts). Again, suppose two pieces of metal (first-order components) are welded together; is the result a first- or second-order component? The assembly in this case is "irreversible."

A full discussion of component design would far exceed the limits of an article; the point to notice in "progressive assembly," however, is the tendency to proceed in stages of assembly, from the simplest unit to the final end product, *via* a series of subcomponents of growing complexity. In my work as a designing engineer I have been very greatly impressed both by the results of progressive assembly

as found in the structure of matter itself and also by the extent to which the leading features of this assembly are applicable to engineering design.

*The analogy of the hierarchy of physical elements*

Matter in its most elementary form is an assembly of two "substances" (I use that misleading term for brevity); namely, protons and electrons. All protons are alike, and similarly there is no difference between electrons so far as is known. About 90 elements are known, and there are good theoretical reasons for supposing that very few remain to be discovered. These elements are assemblies, each consisting of a nucleus and one or more electrons. The third-order component is called a molecule and is formed by the chemical combination of two or more elements. This planet contains over 1,000,000 different sorts of molecules. The next assembly gives us formed matter—stones, mountains, rivers, clouds, etc.—and of these no two are quite alike, the variety running into countless billions. Higher combinations are such structures as crystals, the living cell, and the combinations of cells, forming plants and animals.

Thus, the variety of the components at the various levels of the hierachy is as given in Table 1.

| *Order of Component (or End Product)* | *Name* | *Variety* |
|---|---|---|
| 1 | Proton and Electron | 2 |
| 2 | Elements | About 90 |
| 3 | Molecules | Over 1,000,000 |
| 4 | Formed Matter | Innumerable |
| 5 | Higher Structures | |

TABLE 1

Some characteristics of the various levels can be summed up as follows:

1. At every stage beyond the first a component is formed as an orderly arrangement of simpler components; it is the "ensemble," or the organization itself, which gives the built-up component its peculiar character.
2. At every level the variety of the components is greater than that at a lower or simpler level. Moreover, this increase of variety is very rapid; starting with two at the first level, countless billions are reached at the fourth. The possibility (*not* the necessity) of this depends on a mathematical law and can be foreseen by any mathematician.
3. On the whole, at every level the components will tend to have a less universal application than those in a simpler level. The possibility of this also can be anticipated by a mathematician and is a common feature of every sort of hierarchy; *e.g.*, the scope of action of a general manager is greater than that of his assistants, and so on down the scale.
4. The endurance, or invariability, of the type throughout the ages is, on the whole, greatest in the simplest level and diminishes as complexity increases.

These characteristics result in a system of progressive component assembly in which a very limited number of simple and enduring components are organized by stages into an enormous and flexible variety of end products. An examination of the products of engineering similarly reveals some degree of organization on the lines of progressive component assembly.

*The hierarchy of engineering elements*

At the first and simplest level we find the raw materials of industry—metals, stone, earth, wood, and so forth. The number of these is not great, but the width of application of some of them is very great. The simplest (first-order) components made by man consist of such things as these:

A. Chemical substances depending on their composition only (neither shape nor size involved)—*e.g.*, liquid oxygen, pig iron, etc.

B. Formed matter in which shape and size is relevant but is not completely adjusted to the final applications; *e.g.*, metal rods, sheets, bars, tubes, etc.; wooden planks, and other standard forms; wire; thread; etc.

C. Formed matter in which the shape and size is finally determined and of general applicability; *e.g.*, nuts, bolts, washers, balls for bearings, screws, nails, bricks, piston rings, buttons for clothes, hooks and eyes, spur and pinion wheels (in so far as these are standardized), etc., and some few castings such as cast wedges, etc.

$C^1$. Formed matter in which the shape and size is finally determined, but used only for narrow applications; *e.g.*, most castings (such as cylinder blocks for automobiles), back-axle shafts (automobiles), cloth as cut for individually fitting clothes, stampings for various purposes, many spur and pinion wheels—in fact simple, unstandardized parts of all sorts (*i.e.*, the "standard" is not recognized outside the limits of a particular company or very small groups).

The second order of components consists of as-

semblies of the first group (I am excluding end products from this list):

A. Simple standardized articles; *e.g.*, ball bearings, electric switches (not an end product, for it requires further assembly with an electric circuit), casters (for furniture), carburetors, etc.

A'. Simple unstandardized articles; that is, second-order subcomponents which have an application only to one model of end products; *e.g.*, the steering gear of any given model of automobile; in fact, most second-order components of any mechanical contrivance fall into A' rather than A.

Higher-order components show the same characteristic; namely, that of frequently, but not invariably, having a range of application no wider than one model of end product for which they were specifically designed.

Thus, the organization of progressive component assembly as met with in industry lies somewhere between two rather opposite types, sometimes approaching one extreme and sometimes the other. One extreme is to design and to use each order of components so as to utilize to the greatest extent its possible width of application; this is the method in which matter itself is organized, and a close approach is seen in those subgroups of industrial components marked with unaccented letters above. The other extreme, marked with accented letters, also consists in designing a hierarchy of components which, when assembled in the logical steps, results in an end product, but in which no component at any level has a wider range of application than the particular model of end product for which it was specifically designed.

### *Advantages of progressive component design*

Any form of progressive component design results in more flexible end products than unit design or even simple component design (the logical application of unit design to more complex contrivances). As between the two outstanding types of progressive component design, that type which standardizes each level of components and gives any one component its greatest possible range of application is the method which results in the possibility of the most various (*i.e.*, least standardized) range of end products, or consumers' commodities. This sounds like a paradox, but it is quite simply explained: in the case of an end product in which the components are designed especially for this one purpose, any change in the design of the end product will necessitate shutting down manufacture on several of the components, while a wide variety of models will destroy all the advantages of large-scale production. On the other hand, in so far as the end product is an assembly of standard components with wide application, a change, however radical, would merely involve the selection of other standard parts. For example, a change of automobile design does not seriously affect the manufacture of nuts and bolts, although other sizes may be selected by a given manufacturer. The limitations of this use of progressive assembly of standardized parts will be considered in a moment; for the present, consider its advantages over the assembly of unstandardized or *individual parts.*

These advantages flow partly from the greater ease of introducing both change *through* time (novelty), and change *at* a time (variety), due to the smaller disturbance of manufacturing processes involved. This makes for variety because the manufacture of a wide range of models by any one company does not involve a miscellaneous variety of manufacturing processes, each on a small scale, but merely a more varied choice of standardized parts to be purchased, each particular line being bought in a correspondingly smaller quantity. Manufacture is dissociated from assembly and so increases standardization in the former with advantages to production methods, while assisting individuality in assembly and in the final consumer's commodities.

The advantages to manufacture are many:

1. A manufacturing program is not dependent on the fluctuations in style of any one end product; hence, a greater stability of type and of demand, change being introduced only as dictated by genuinely improved methods or materials.
2. Greater width of application of a component not only increases the life of a given design, but increases its width of application at any instant, and so demand; this again assists economical manufacture.
3. A manufacturing company, having a wide experience in the production of its particular line, will be in an excellent position to conduct research and experiment leading to progressive improvement. The increased demand would diminish the economical time intervals between such changes; moreover, the actual machines employed in manufacture might be designed on the same principle as the end products and so might further increase flexibility. Not all improvement in a component alters the use of the latter; *e.g.*, an improved ½-inch bolt with a given pitch of thread would have the same nominal dimensions as before, but would adhere more closely to limits or be made from

better steel. Thus, improvement in components, wisely introduced, would not upset an assembling program.

These are some of the manufacturing advantages of the progressive assembly of standardized parts. As regards assembly, this is usually more elastic than machine work, variations implying less scrapping and rearrangement of plant.

A specific advantage would arise if the possibilities of assembling a greater variety of end products were fully exploited; for this would tend to put demand back onto a rational, and therefore predictable, basis; and unsuccessful models, not being tied with manufacture, could be quickly eliminated. Again, inasmuch as many new models fail to sell because of the defective design of some component (which is as new and untested as the model itself), this danger would be greatly reduced.

### *Objections considered*

I have skimmed very lightly over a number of engineering and manufacturing problems which cannot be elaborated here, but it is clear that there are certain limitations to this type of progressive assembly. A question arises as to whether the variety required in sizes and shapes of standard components would not be so great as to defeat its own ends. I can speak only from the standpoint of a mechanical engineer, but in this field, at least, I think that the objection does not hold. Balls for bearings are manufactured to limits of about $\pm 0.0001$ of an inch; this is not because such a small difference between two bearings would have the least influence on their action, strength, or applications, but merely because the balls must fit their races accurately and the latter must fit their housings. Consequently, ball bearings (which are standardized for practically all purposes) are made to very fine limits, but the intervals between successive sizes are quite coarse, commonly an eighth or a quarter of an inch on the diameter, depending on the types and sizes considered. The same thing applies to screws, nuts, washers, split pins, cotter pins, and a host of other simple standardized units. This would also apply to other similar parts not yet standardized, or only partly so, such as spur and pinion wheels, back-axle shafts for automobiles, etc. It must be remembered that in the absence of any such standards each designer uses individual dimensions, and a wide and meaningless variety of components results. But the whole range of automobiles could probably be easily met by a choice of two dozen carefully graded back-axle shafts, provided that these alternatives were known to the designers in advance. This sort of standardization already applies to batteries, and the required range of these is small compared to that of automobile models; the same also applies in varying extents to magnetos (when used), electric bulbs for homes and other uses, carburetors, etc.

Components of a higher order can be found in which this type of standardization has been developed—*e.g.*, in pump assemblies—and the smaller range and lesser endurance of higher components is partly compensated by the fact that, in these, assembly would predominate over actual manufacture.

Practical engineers will look in the regions of framework or housings and those exterior parts of a commodity which affect the "style" (largely operative through the sense of sight) for the most obvious limitations of the kind of designing here advocated. Obviously, many limitations exist, but in practice these are not nearly reached and have not been systematically explored. "Mass production" has drifted rather blindly towards standardization of the consumer's commodity, coupled with a relatively great variety of components, rather than the reverse. Clearly, though we may desire a variety in bathroom faucets as regards their style and capacity, a rigid standardization of the parts involved in their inner mechanism could be only a blessing. For, though we desire variety in the final commodity, this desire affects only a small proportion of the components themselves and their arrangement (assembly); and my whole thesis is that standardization of the component parts assists an economical variability of the whole.

The evolution of the progressive component design of standardized parts must usually start from the simplest units upwards; at the lowest level this is already largely accomplished and, on the whole, represents the modern drift.

Would the realization of the possible advantages do anything to hasten this process, or are product planners already doing all they can to fit their products to the industry as they find it? Of course, a designer works for the profits of his company and is not expected to lead a crusade; to this extent all evolution of method may be said to look after itself. But this is not the whole story. As between two or more alternatives, we choose that one which seems to suit the case best; this applies to such diverse matters as selecting between candidates for a job or between designs for a mechanical contrivance. But after the more obvious *pros* and *cons* have been weighed and balanced, it often happens that no certainty is reached; so many factors have been ignored, or their importance roughly guessed, that the alternatives, though perhaps very different, seem

about equally desirable. This does not imply that the choice is thought to be immaterial; it is often obviously vital, but Heaven alone knows the ultimate consequences involved in either decision. These are the moments in which we all seek guidance in some general principle, and one very powerful guide is a settled belief as to which alternative has the future with it; which, in other words, is "forward looking." Anyone who has watched the introduction of radical departures involving serious financial risk must have observed that the "coming" method or device is habitually adopted before a cold calculation of advantages would really warrant the action. For instance, the introduction of motor ocean ships occurred at exactly this stage, and the ship companies buying motor ships must have been influenced by the possible advantages of gaining early experience in the handling of the "coming" type of engine. This alone makes possible the future development of these engines and so helps to bring about the very economies which the ship companies were hoping for and anticipating.

I wish particularly to stress this point, for it is not always realized to what an extent the actual decisions of engineers and scientists generally are based on judgments backed by very inadequate data. A report as presented to the higher executives may look logical and smooth enough, and mathematical reasoning has no doubt been freely used to assist the final judgment; but all this rationalization must not blind us to the fact that the selection of data on which the argument is built, as well as the weighting of conflicting evidence, depends in the last resort on sheer judgment and on nothing else. Consequently, in product planning (as in most other activities) the general trend is immensely influenced by any relevant idea which may cause the "slack" or "area of uncertainty" to be taken up habitually in one direction rather than in another. For this reason it seems probable that, if product planners (engineers and others) were ever to feel the desirability of obtaining a wide variety of end products by an intelligent standardization of components, this would in itself be just as powerful an influence as has been the unfortunate idea that the benefits of large-scale production require a rigid standardization of end products with the consequent impoverishment of their variety.

Obviously, such bodies as trade associations, and possibly government investigations and actions relative to ways and means of standardizing components, would assist; but these can only follow a general recognition of the need, and they are probably no more indispensable to a new form of standardization than they were to the old.

# Report on Steel Embrittlement Published by A.S.T.M.

A report of an extensive investigation on the embrittlement of hot-galvanized structural steel, which was carried out at Battelle Memorial Institute under the direction of a committee of the American Society for Testing Materials, has been published by the A.S.T.M. The study was undertaken following a request from the Sectional Committee on Specifications for Zinc Coatings of Iron and Steel (G8) that the A.S.T.M. sponsor such an investigation on embrittlement phenomena. The committee had found that the embrittlement of galvanized rolled structural steel was important in its work of developing specifications for this product.

Over 170 heats of bessemer, duplex, and openhearth steel in the as-rolled, pickled, and galvanized conditions, with punched and drilled holes, were examined in several thousand tests. The results of these examinations are summarized and given in charts and tables in the report.

The report as published includes a section comprising recommendations to the Sectional Committee on Zinc Coating of Iron and Steel (G8) relating to standard specifications for zinc (hot-galvanized) coatings on structural steel shapes, plates, and bars, and their products. It also includes the Standard Specifications for Zinc (Hot-Galvanized) Coatings on Structural Steel Shapes, Plates, and Bars, and Their Products (G8.1-1930) (A.S.T.M. A 123-30), and the A.S.T.M. Tentative Recommended Practice for Safeguarding Against Embrittlement of Hot-Galvanized Structural Steel Products and Procedure for Detecting Embrittlement (A.S.T.M. A 143-32 T).

The committee which directed the investigations included representatives of steel manufacturers, galvanizers and fabricators, users, and zinc manufacturers, to all of whom a true understanding of the causes and cure for embrittlement is most important. These industries contributed many thousands of dollars in money and materials to carry on the work.

The report may be purchased at one dollar per copy from the American Society for Testing Materials, 1315 Spruce Street, Philadelphia, or through the office of the American Standards Association.

## Commercial Standard for Wool and Part-Wool Blankets

The National Bureau of Standards has promulgated a Commercial Standard for Wool and Part-Wool Blankets which will become effective for new

production and clearance of existing stocks on December 31, 1932.

The standard provides methods of labeling wool and part-wool blankets in order to indicate the percentage of wool content in the blankets. According to the standard, no blanket containing less than 5 per cent wool may carry the word "wool" in any form. Any blanket containing between 5 and 25 per cent wool shall be labeled "Part wool not less than 5 per cent wool." Blankets containing more than 25 per cent wool are to be labeled with the guaranteed minimum percentage of wool content. Any blanket containing above 98 per cent wool may be labeled "All wool." The wool percentage indicated in the standard refers to the fibers employed, and means the percentage of wool in the entire blanket, and not in the filling alone.

The standard has been printed by the Government Printing Office and may be purchased from the Superintendent of Documents, Washington, D. C., at five cents per copy.

# Foreign Standards Available from ASA

New foreign standards available to Sustaining-Members for loan or purchase through the ASA office are listed below. They are available in the language of the country under which they are listed. In requesting copies of the standards it is necessary to list only the ASA serial numbers preceding the titles. Send either a post-card or a note containing only the name and address of the person wishing to receive the standards, and the numbers of the standards desired. The card or envelope should be addressed to the American Standards Association, 29 West 39th Street, New York.

*Serial Number*

*Germany*

274. Manhole frames and covers for highways, cover with ribbed surface, nominal size 500 and 600
275. Manhole frames and covers for highways, circular frame with flanged bottom, nominal size 500, 600, and 700
276. Manhole frames and covers for highways, square frame with plain bottom, nominal size 500 and 600
277. Manhole frames and covers for highways, square frame with plain bottom, nominal size 500 and 600
278. Manhole covers for highways, square frame with plain foot, nominal size 510
279. Manhole frames and covers for roads with vehicle traffic, reference sheet
280. LNA pipe, semi-beveled crosses, sewage disposal
281. LNA pipe, semi-beveled T's, sewage disposal
282. NA pipe, semi-beveled crosses, sewage disposal
283. NA pipe, semi-beveled T's, sewage disposal
284. Symbols for maps, surveying methods

286 to 288. Case-hardened chromium nickel steel, directions for heat treatment, materials of construction, ECN 25; ECN 35; ECN 45 (*three standards*)

289. Case-hardened nickel steel, EN 15, directions for heat treatment, materials of construction

290 to 296. Tempered chromium nickel steel, directions for heat treatment, construction materials, VCN 15w; VCN 35h; VCN 45; VCN 15h; VCN 25h; VCN 25w; VCN 35w (*seven standards*)

297. Fusion welding, welded joints
298. Narrow cap nuts
299. Swivel nuts, short hexagonal type
300. Pin insulator, series HD, for overhead power lines operating voltage 0.5 to 35 kV
301. Pin insulator, series HW, for overhead power lines operating voltage 0.5 to 35 kV
302. Reinforced pin insulator, series VHD, for overhead power lines, operating voltage 0.5 to 35 kV
303. Reinforced pin insulator, series VHW, for overhead power lines operating voltage 0.5 to 35 kV
304. Specifications for compression tests with cubes, in connection with concrete (plain and reinforced) building construction
305. Specifications for flat brick floors
306. Specifications for plain concrete construction
307. Specifications for reinforced concrete building construction
308. Standard symbols for reinforced concrete construction
309. Threaded pipe connections for automobile and aircraft construction, crosses
310. Threaded pipe connections for automobile and aircraft construction, elbows
311. Threaded pipe connections for automobile and aircraft construction, review sheet
312. Threaded pipe connections for automobile and aircraft construction, T's

*Belgium*

285. International symbols—part 3—Graphical symbols for weak current installations

ASA PROJECTS

# A Review of Mining Projects Under ASA Procedure

*The second of a series of reviews of standardization projects under the procedure of the American Standards Association*

The status of all mining projects under ASA procedure is summarized in the following review. The data presented are taken from the files of the American Standards Association and are corrected to November 1, 1932, bringing up to date the review of mining projects published in the December, 1931, issue.

## M2-1926—Safety Rules for Installing and Using Electrical Equipment in Coal Mines

*Sponsors*—American Mining Congress; U. S. Department of Commerce, Bureau of Mines.

This standard, approved as American Standard on October 8, 1926, is generally recognized in American coal-mining practice. No revisions are under way at present.

## M5-1932—Methods for Screen Testing of Ores

*Sponsor*—American Institute of Mining and Metallurgical Engineers.

Research studies of crushing problems undertaken by the Milling Committee of the American Institute of Mining and Metallurgical Engineers in 1922-26 brought out the need for standardizing methods for screen testing of ores. A draft prepared by this committee received considerable circulation in the mineral industries during 1929-30. Comments resulting from this canvass were considered by a subcommittee, which drafted the technical provisions of the proposed standard in final form, and submitted them to the Milling Committee of the A.I.M.E. for letter-ballot action late in 1931.

Submission of the standard to ASA was made by the sponsor in February, 1932, and approval as American Recommended Practice was given by ASA on July 6, 1932.

In approving this standard, attention of users has been called to the work of the Sectional Committee on Sieves for Testing Purposes (Z23), which may ultimately affect some of the provisions of this standard. Approval does not prejudice any future recommendations from the sectional committee on sieves.

The standard was published by the A.I.M.E. in its journal, *Mining and Metallurgy,* October, 1932. Separate copies are now available from the ASA office at 25 cents each.

## M6-1931—Drainage of Coal Mines

*Sponsor*—American Mining Congress.

A revision of this standard covering recommended practice for the drainage of coal mines was approved on October 1, 1931, after consideration by a sectional committee actively directed by the American Mining Congress.

The text of this standard presents detailed recommendations covering the installation and operation of mine drainage equipment. Among the topics covered are the following: pumps, piping, storage of mine waters, limitations of natural drainage, methods of unwatering abandoned workings, the effect of mine waters on drainage equipment, and recommendations regarding the use of acid-resisting metals and alloys.

Since its publication, copies of the standard have been distributed to all state regulatory bodies, to engineers of the U. S. Bureau of Mines, and various state mining bureaus, as well as to many coal-mining operators.

## M7a-1927—Coal Mine Tracks, Signals, and Switches

*Sponsor*—American Mining Congress.

Revision of this standard was decided upon at a meeting held by the sponsor, the American Mining Congress, in May, 1930. A program outlining several sub-projects to be handled by subcommittees was presented. Of these subcommittees, that on frogs, turnouts, and switches, and a second on mine ties have made progress. Recent advice from the American Mining Congress indicates that proposed standards covering designs for frogs and turnouts for coal-mine tracks for both gathering and main-line haulage purposes have been completed. It is expected that these

will shortly be ready for consideration by the sectional committee.

## M10-1928—Miscellaneous Outside Coal-Handling Equipment

*Sponsor*—American Mining Congress.

This standard was approved as American Tentative Standard on July 31, 1928. The text of the standard includes sections on systems of signals for hoisting, recommended safe methods for tipple practice, and fire protection of shafting and structures adjacent to mine openings. It may be separated into three documents when revision is undertaken.

## M11-1927—Wire Rope for Mines

*Sponsor*—American Mining Congress.

Approved as American Tentative Standard on February 24, 1927, this specification for wire rope has had wide distribution. Requests for the standard have been received, not only from mining companies, for which it was developed, but also from many other industries, as the rope specified is suitable for many industrial purposes.

## M12-1928—Construction and Maintenance of Ladders and Stairs for Mines

*Sponsor*—American Mining Congress.

In the development of this standard, which was approved as American Tentative Standard on May 9, 1928, its provisions were correlated with those contained in the Safety Code for the Construction, Care, and Use of Ladders (A14-1923). Revision of the latter standard is now before its sectional committee for consideration. Should this revision be adopted, consideration will be given to the question of revising the mine ladder code.

## M13-1925—Rock Dusting of Coal Mines

*Sponsor*—American Institute of Mining and Metallurgical Engineers.

This important measure for safeguarding the life of workers and minimizing property damage in coal mines was adopted as American Recommended Practice on December 30, 1925.

Rock dusting of coal mines, first proposed to the Director of the U. S. Bureau of Mines by George S. Rice in 1910, was officially approved by the Bureau in 1913, and, subsequently, adoption followed in several European countries.

Since the introduction of rock dusting in the United States, a continuous campaign to promote its more extended use has been carried on by Bureau engineers. The present code is based upon recommendations of the Bureau of Mines, which is maintaining its active sponsorship of the value of rock dusting as a safety measure.

Recognition of the importance of rock dusting as a safety measure has now become general, largely because in several instances explosions in rock-dusted mines have been localized, whereas without rock dusting they might have been major disasters.

## M14-1930—Use of Explosives in Bituminous Coal Mines

*Sponsor*—Mine Inspectors' Institute of America.

This code, covering the handling of explosives in bituminous coal mines, was approved as American Recommended Practice in April, 1930. No requests for revisions have been received.

Consideration has been given to the possible development of similar safety codes for the use of explosives in anthracite and also in metal mines. Projects along these lines have not yet been initiated.

## M15-1931—Safety Code for Coal Mine Transportation

*Sponsor*—American Mining Congress.

Recommendations for safe operating conditions in underground transportation and in surface yards, as well as upon slopes or inclines leading underground, are presented in detail in the Safety Code for Coal Mine Transportation, which was approved as American Recommended Practice on January 24, 1931. Copies of this standard have been distributed through the U. S. Bureau of Mines and state mining officials to the staffs of these organizations, and also to coal-mining companies in the United States and Canada.

## M17-1930—Fire Fighting Equipment in Metal Mines

*Sponsors*—American Mining Congress; National Fire Protection Association.

This standard was approved as American Recommended Practice on October 14, 1930. Although favorably received by the mining industry and in use by many large mining companies, its general adoption has been hindered by the almost prostrate condition of the mining industry at the present time.

## M18-1928—Underground Transportation in Metal Mines

*Sponsor*—American Mining Congress.

Revision of this standard, approved on May 26, 1928, has been under consideration by the sponsor, the American Mining Congress, for some time. Plans for expanding the project have been proposed, but little progress has been made.

## M19-1928—Mechanical Loading Underground in Metal Mines

*Sponsor*—American Mining Congress.

The present document, approved as American Recommended Practice on April 2, 1928, was intended to indicate the general lines that standardization might follow to be more effective for mechanical loading in metal mines. Recommendations giving general requirements for shoveling and scraping machines, and suggestions regarding their operation, were included. Consideration has been given to a revision and an extension of the present standard.

## M20—Classification of Coals

*Sponsor*—American Society for Testing Materials.

The viewpoint of all connected with this project, which was undertaken at the request of the Coal Mining Institute of America in 1927, has been that any system for the classification of coal should be useful and practical, as well as technically sound. During its development, technical committees and subcommittees have been actively engaged in the correlation of available information and in obtaining data by research. Investigations have been carried out to determine the suitability of different coals to various consumers, to study the occurrence, composition, and origin of North American coals, and to consider suggested systems of classification. Papers and reports covering various phases of this work have appeared in the technical press, have been presented at meetings of technical societies, and have been published in Industrial Standardization. The report for the year ending June, 1932, was published by the sponsor, the American Society for Testing Materials, as Preprint 74, and was reprinted in Industrial Standardization, July, 1932.

Active cooperation has been maintained with a Canadian group—the Associate Committee on Coal Classification of the National Research Council of Canada—engaged upon a similar project, by attendance of members of the two committees at meetings of both groups, and by interchange of information regarding the assignment and progress of research investigations. Contact with foreign countries has been carried on through the chairman of the American Committee of the World Power Conference, O. C. Merrill.

As reported at the latest meeting of technical committees, held in Atlantic City on October 10, marked progress is being made in setting up boundaries and specifications for different classes of coal. It was indicated that a tentative system for classifying coals by rank and according to type may be ready for consideration at the next annual meeting of the sectional committee, scheduled for February, 1933, in conjunction with the winter meeting of the American Institute of Mining and Metallurgical Engineers in New York City.

## M21—Specifications for Coal-Mine Cars

*Sponsor*—American Mining Congress.

This project, originally a part of a more general project for coal-mine transportation, was initiated in 1929. Investigation by the American Mining Congress has indicated that standardization of coal-mine cars should be confined to specifications covering details such as couplers, draw bars, wheels, bearings, bumpers, etc. Although it is realized that standardization of these important pieces of coal-mine equipment will involve a campaign of several years' duration, it is believed that possible savings to the operators and to car manufacturers warrant undertaking this program.

## M22—Mine Timbering

*Sponsor*—American Mining Congress.

This project was initiated in 1930. A draft covering preservative treatment of mine timbers was circulated in 1931. Recent advice from the sponsor indicates that the sectional committee is now being reconstituted.

## M24-1932—Safety Rules for Installing and Using Electrical Equipment in Metal Mines

*Sponsor*—American Mining Congress.

The development of the above standard was undertaken in 1930 by a sectional committee under the leadership of the American Mining Congress. Four drafts were prepared and given wide circulation in the metal-mining industry. Adoption by the sectional committee and endorsement by the sponsor came only in 1932. The standard was approved as American Recommended Practice on August 23, 1932.

The provisions of the new standard cover approved methods for installation and operation of electrical equipment in and around metal mines. The following important topics are covered: general supervisory requirements, stationary electrical equipment located

underground or in buildings and enclosures on the surface, portable electrical equipment, substations and conductors for both stationary and portable equipment, and a section defining the terms used in the text of the standard.

Copies of this standard are not as yet available for distribution, but the American Mining Congress expects that the standard will soon be published.

## M25—Specifications for Trolley, Storage Battery, and Combination Type Locomotives for Coal Mines

*Sponsors*—American Institute of Electrical Engineers; American Mining Congress; National Electrical Manufacturers Association.

Initiated in 1929, with the American Mining Congress and the National Electrical Manufacturers Association as sponsors, this project was altered early in 1930 by the addition of a former electrical project—Electric Mine Locomotive Control Apparatus (C49). The American Institute of Electrical Engineers joined with the two bodies mentioned above and all three are now serving as joint sponsors. Progress in the preparation of locomotive standards is being made by the Mining and Industrial Locomotive Section of N.E.M.A. About 40 items are under consideration by this group and in the main have been accepted by the several manufacturers concerned. Suggestions from the American Mining Congress with regard to motor ratings have been incorporated with the topics being considered by the N.E.M.A. committee. These preliminary investigations by committees of the sponsors will be available as a basis for the work of the sectional committee.

# Safety Code Committee Elects Officers

At the meeting of the Safety Code Correlating Committee held in Washington on October 7, 1932, new officers for the ensuing year were elected. The chairman, C. E. Pettibone, vice president and chief engineer of the American Mutual Liability Insurance Company, has been a member of the Correlating Committee for a number of years, and is also a member of Standards Council representing the National Association of Mutual Casualty Companies. L. F. Adams, who has been for some time a member of the Committee representing the National Electrical Manufacturers Association, was elected vice chairman. The Executive Committee, in addition to the officers, includes T. P. Kearns, superintendent, Industrial Commission, Columbus, Ohio; W. D. Keefer, director, Industrial Safety Division, National Safety Council, Chicago; M. G. Lloyd, chief, Section of Safety Standards, National Bureau of Standards, Washington, D. C.; J. A. Morford, executive secretary, New York State Economic Council, Inc., New York; and W. S. Paine, manager, Engineering and Inspection Department, Aetna Life Insurance Company, Hartford, Conn.

Among the important items discussed by the SCCC were the initiation of two new projects: Methods of Test and Performance Requirements for Non-Shatterable Glass; and Work in Compressed Air. Action was taken recommending the initiation of these two projects to Standards Council.

The recommendation of the Correlating Committee in reference to the project on non-shatterable glass has already been acted upon by Standards Council and the development of the project will go forward under the sponsorship of the National Bureau of Casualty and Surety Underwriters. No formal action has been taken on the Safety Code for Work in Compressed Air as a definite decision has not as yet been rendered concerning sponsorship.

Important action was also taken on two projects which have been inactive for a number of years and which are of prime importance to industry in general. These projects apply to ventilation and to exhaust systems. In connection with the Ventilation Code (Z5), a recommendation for the continuance of sponsorship by the American Society of Heating and Ventilating Engineers was made, and the sponsor is now proceeding with the organization of the sectional committee. This committee will have for its immediate consideration the code recently approved by the sponsor, which has been forwarded to ASA for consideration as the basis of American Standard Specifications for Heating Systems.

In reference to exhaust systems, the Correlating Committee recommended the approval of the New York State Code for the Removal of Dust, Gases, and Fumes as American Recommended Practice and the immediate formation of a sectional committee to undertake a revision of this code for advancement to American Standard. This recommendation has been submitted to formal letter ballot of the Correlating Committee before final recommendation is made to Standards Council.

Ethelbert Stewart, former Commissioner of the Bureau of Labor Statistics and former secretary of the International Association of Industrial Accident Boards and Commissions, presented his resignation as a member of the SCCC. Mr. Stewart took this action with extreme regret. He had taken an active part in the development of the SCCC code program

from the time of its inception and the committee was glad to find that he would be able to maintain contact with the work through his honorary secretaryship of the IAIABS. A. R. Small, representing the National Fire Protection Association on the Committee, spoke of the effectiveness and vigor with which Mr. Stewart had entered into every phase of the work of the SCCC. He stated that the members had learned that Mr. Stewart's bite was not as bad as his bark, notwithstanding the fact that when he considered it necessary his bite was sharp, clean, and effective. By his courage, vision, and unfailing humor, he said, Mr. Stewart had so won the admiration and affection of the members that the Committee could not continue without him. He, therefore, moved the following resolution:

RESOLVED, that Ethelbert Stewart be made an honorary member of the Safety Code Correlating Committee.

The resolution was carried by a unanimous rising vote.

## New Standards for Wires and Cables May Be Purchased

The following standards, recently approved by the American Standards Association, have been published by the American Institute of Electrical Engineers:

American Tentative Standard for Weatherproof Wires and Cables (C8k1-1932)

American Tentative Standard for Heat-Resisting Wires and Cables (C8k2-1932)

American Standard Definitions and General Standards for Wires and Cables (C8a-1932)

The standards for weatherproof wires and cables and for heat-resisting wires and cables may be purchased at 20 cents each, and the standard definitions and general standards may be purchased at 40 cents each from the American Institute of Electrical Engineers or from the American Standards Association. A schedule of quantity discounts, advantageous to companies wishing to use a large number of the standards either in their own organizations or as promotion material, has been set up.

Announcement of the approval of the standards was published in the July, 1932, issue of INDUSTRIAL STANDARDIZATION.

The Electrical Standards Committee is sponsor for the project.

## Tolerances Included in Specifications for Cement

Minor editorial changes, to include tolerances for limits of chemical properties, have been made in the text of American Standard Specifications for Portland Cement (A1a-1931) (A.S.T.M. C 9-30). As originally issued, limits for chemical properties appeared in Section 2 of the Standard Specifications for Portland Cement; and tolerances for these limits were given in the Standard Methods of Testing Portland Cement (A1b-1931) (A.S.T.M. C 77-30). A revision of the Standard Methods of Testing Portland Cement is now being considered by the sectional committee, following its adoption by the American Society for Testing Materials, sponsor for the project. In connection with this revision, tolerances for the chemical limits have been transferred to the standard specifications and now appear in Section 2 as follows:

| | *Limits* | *Tolerance* |
|---|---|---|
| Loss on ignition, per cent | 4.00 | 0.25 |
| Insoluble residue, per cent | 0.85 | 0.15 |
| Sulfuric anhydride ($SO_3$), per cent | 2.00 | 0.10 |
| Magnesia (MgO), per cent | 5.00 | 0.40 |

### ASA Considers Revision of Standard for Concrete Reinforcing Rods

A revision of the American Standard on Steel Spiral Rods for Concrete Reinforcement (A38-1927) (Simplified Practice Recommendation R53-26) has been submitted to the American Standards Association by the joint sponsors, the Department of Commerce—Bureau of Standards, and the Concrete Reinforcing Steel Institute. The revision has been accepted by industry as a revision to Simplified Practice Recommendation R53-26 under the procedure of the Division of Simplified Practice of the National Bureau of Standards. Approval of the revision is now under consideration by ASA.

The revision consists largely of a rearrangement of the tabular form in which certain data are presented, and the removal to tables in an appendix of other data now given for informational purposes.

### Burke Member of Committee on Classification of Coals

Dr. S. P. Burke, West Virginia University, Morgantown, West Virginia, has been elected member-at-large of the Sectional Committee on Classification of Coals (M20).

# American Standards of Safety in the Construction Industry[1]

*by*

W. R. Smith[2]

*The value of national standardization methods in providing a textbook on safety for the use of all branches of the construction industry*

I am sure that all individuals like yourselves, who have what is characterized as an engineering turn of mind, and who naturally, even inherently, move forward toward any goal by way of what Dr. R. A. Millikan has defined as "the scientific approach," will agree with the point of view that only through controversy and compromise can the right answer be found to any problem involving human knowledge, experience, and relationships.

By many with whom we all come in contact in our daily lives, both in a social and in a business or professional way, this is not understood—and I use the term "understood" advisedly; for it is a matter of understanding, and not one of just accepting the statement as a fact because someone says it is so. In order to understand and accept any fundamental principle, we must have acquired the habit or characteristic of open-mindedness and of broad-mindedness, and must have come to the realization that the sum total of human knowledge and experience is not contained within the area bounded by our own limited horizon. We have but to let our minds review the progress made by men throughout the ages to realize that the very holding of such a meeting as this, under these conditions, made possible by man's discoveries and inventions, would be out of the question—and, in fact, our minds would not have reached their present state of development and understanding—had those who have gone before been content to remain within the confines of their own horizons.

It is, therefore, the controversy and the subsequent compromise that make it possible for us to make progress and, in any given instance, to arrive at the proper mean—that average condition which is usable and workable. Certainly in the development of any document which has for its aim the improvement of a condition, the promoting of efficiency, or the effecting of economy, the time for all discussion, for the presentation of all points of view, and the advancement of all technical or psychological arguments, is during the preparation of the data, and not afterward.

It seems to me, therefore, that in no other way could the leaders in our scientific and industrial fields have as effectively demonstrated their belief in the soundness of the policy of encouraging controversy in order that the truth might come out than through the establishment of the agency which was to serve as an open forum in such respects—the American Standards Association. In effect, this institution extends an invitation to any representative group to contribute out of its knowledge and experience to any standards that are in progress of development, with the acceptance always of the condition that there will be many other points of view equally entitled to consideration.

### *Scope of project*

It is under such procedure, and sponsored by the National Safety Council and the American Institute of Architects, that the development of the safety standards for the construction industry is going forward.

The scope of this piece of work is as follows:

> Construction, demolition, and repair of building, including excavation, foundation work, steel erection, scaffolding, lighting, openings, temporary floors and stairs, in relation to accident hazards to employees and to the public.

The assignment is in the hands of a thoroughly representative committee as regards those organizations, institutions, and agencies closely identified with the great construction industry.

The personnel represents the following organizations: American Institute of Architects; American Society of Civil Engineers; American Society of

[1] Presented at the meeting of the Engineering Section of the American Society of Safety Engineers, held during the National Safety Congress in Washington, D. C., October 4, 1932.

[2] Assistant chief engineer, United Engineers and Constructors, Inc., Newark, N. J.; chairman of the Sectional Committee on Safety Code for Construction Work (A10), under ASA procedure.

Mechanical Engineers; Associated General Contractors of America; Association of Governmental Officials in Industry; Building Officials' Conference; International Association of Industrial Accident Boards and Commissions; National Association of Builders' Exchanges; National Association of Building Trades Employers; National Association of Mutual Casualty Companies; National Bureau of Casualty and Surety Underwriters; National Safety Council; National Bureau of Standards; and the United States Department of Labor.

However, the opportunity to be consulted and thus enabled to contribute to the work does not stop with these organizations but also extends to the various trade and business associations in all fields allied with the industry and serving it in any way related to the scope of the standards. As examples, we might cite such organizations as the American Concrete Institute, American Institute of Steel Constructors, Heating and Piping Contractors National Association, Electric Hoists Manufacturers Association, American Welding Association, and the Plumbing and Heating Industries Bureau.

It may be of interest to many of those present who are not familiar with American Standards Association procedure to know from whence the personnel of such a committee is drawn. The representation must be from six different interests as follows:

1. Manufacturers of materials and equipment
2. Employers
3. Employees
4. Insurance interests
5. Governmental officials
6. Technical experts

The advantages to such work of having representation from all of these interests will be apparent. Conflicting or competing standards are undesirable and to be avoided in all matters of this kind. Saying the same thing in many different ways is confusing, and ultimately leads to controversy of a serious nature which cannot easily be compromised. It is, therefore, desirable that all concerned work and cooperate together to establish the standards for the industry, which should, when completed, constitute a real consensus of the very best opinions and judgments on the subject.

No one in any way familiar with the broad scope of the construction industry, and certainly no member of this organization, made up as it is of men on whom rests the responsibility for supervising in a technical way the procedure with regard to safety of workers, of other employees, and of the property of employers and the public, can fail to realize the extensiveness of the scope of the standards that this committee will be called upon to develop. The amount of discussion that will be necessary and the points of view that will have to be adjusted will no doubt be appreciated, at least to some extent.

In my opinion the success that will be attained, and the usefulness and workability of the document when it is completed, will be determined by the open-mindedness of those who have this responsibility resting upon them and who are approaching this obligation with a realization that the construction industry can set forth the fundamentals that it considers essential, and at the same time can state what it considers to be the best practices for specific conditions, which may then be defined as American Standards.

### *What standard means*

And just here I would direct attention to the significance of the term "standard" as it should be interpreted in connection with all matters of this kind. A standard as adopted at any given time is but the concise interpretation, for the benefit of all, of what may be regarded as the best practice out of our accumulated technical knowledge and experience. But do not permit yourself to think of a standard as something stagnant. It is king—yes—but only for a day, and wherever our standards have handicapped us in the past I am sure that an analysis would have shown that the fault was with us who came after and not with those who took what was a progressive step when the standard was established.

And so, again, in the selection of data, and the determination of the degree to which it should be specific, many divergent opinions need to be focussed and averaged. Progress can the more readily be made when it is accepted, by all concerned, that all that is being attempted is the setting down of what the industry deems to be the best at the particular time, and that the same opportunity will be provided for bringing about revisions to keep the standards up to date as was the case during the formulation of the original subject matter. Obviously, in addition to the exercising of extreme care in the selection of the data from the technical point of view to the end that the provisions and requirements may be regarded favorably by all, endorsed whole-heartedly, and observed faithfully, there is the other important consideration of the use to which such standards may possibly be put and the influence that such consideration should have on the character of the document and its detail requirements.

But again we are reassured when we consider the breadth of vision that is possessed by the committee by virtue of the representation of all branches of the

industry. The truth of a statement made in August, 1931, by Bancroft Gherardi, president of the American Standards Association, anent the subject of safety codes, is of great significance in this connection:

> "Industries, like people, are more willing to abide by regulations which they set up for themselves than they are to follow rules laid down by some external agency. Because the provisions included in these national codes represent a crystallization of the accumulated wisdom of industrial experience and are the result of painful trial and error in many cases, they constitute a symposium of the best methods of meeting the technical problems of safety and, therefore, they become the guides for industry itself and are voluntarily adopted and followed. In their development, industry has taken the leadership and has supplemented its own knowledge by the experience of insurance companies and regulatory bodies."

Perhaps the point of greatest controversy in connection with this whole subject of codes and standards is the question of legislation, and rightly so, because of the very great hardship that can be brought upon an industry and the workers in it when ill-advised agencies produce documents of this character and then proceed to have them enacted verbatim into law. In the majority of instances those who respond to the urge from some quarter to develop such data for enactment into law are not sufficiently expert technically and do not possess judgment which has been matured by experience with the subject before them. Partisan interests then sway opinions and bring about action which is inconsistent with the methods and technique of the industry. Furthermore, when such requirements and provisions have been enacted into law, even typographical errors and obvious inconsistencies, to say nothing of changes desirable because of the advances in the art or in technique, are corrected only through legislative procedure, often requiring more effort than was put forth to have the law passed in the first place.

If, on the contrary, a national code were the document being used as a standard of procedure by anybody, whether legislative or not, it would be a comparatively simple matter to bring about a revision and, with the endorsement of the responsible organizations, its observance without delay by all concerned could be anticipated.

### *A text book needed*

We are, perhaps, all of one mind with regard to the fundamental correctness of the statement that education is the way out of practically all of our difficulties, in whatever walk of life we may find them. In the days when opportunities were offered to the young and inexperienced to serve a term of apprenticeship in the presence of, and at the feet of, those who were masters of their art and who were also endowed with the ability to pass on their knowledge to the attentive worker, there was perhaps a minimum of need for text books, or for anything that may be likened to such a record of experience.

The present day, however, finds us confronted with a different and a more difficult problem. In this construction industry there are many who are attentive to this subject of construction safety, but who are denied the contacts that would prove helpful. There is still a larger group, perhaps, made up of those who are disinterested, and who may eventually furnish occasion for the attempts to bring them into line by legal procedure.

Now, to my mind, and from whatever point of view the subject is approached, there is conspicuously evident the need for a text book on this subject, to be produced by the construction industry, and which can serve the purposes of any and all groups.

Complacency on the part of those organizations which have been successful in controlling their own safety records through well-thought-out plans and procedure is not sufficient for the needs of the times and will not improve the general conditions which indirectly affect every enterprise associated with the industry.

It behooves this industry, therefore, as it does all others, to produce the proper documents by controversial discussion in properly selected committees, and through compromise to select a practicable and workable standard which is the best for the time, and which permits another step forward.

Then we should advance to the position thus made possible by the standard, support it, observe it, invite its utilization by all who need it, and thus create respect for the standard itself and the industry that produced it.

## Correction

A statement in the article "American Standard Forms for Concrete Construction Floors," page 296 of the November issue, which said "The standard is a revision of Simplified Practice Recommendation R87-31" is in error. This sentence should have read "The standard is identical with Simplified Practice Recommendation R87-32, which is a revision of the earlier edition R87-29."

# Standard Practice for Scientific Charts for Lantern Slides Approved by ASA

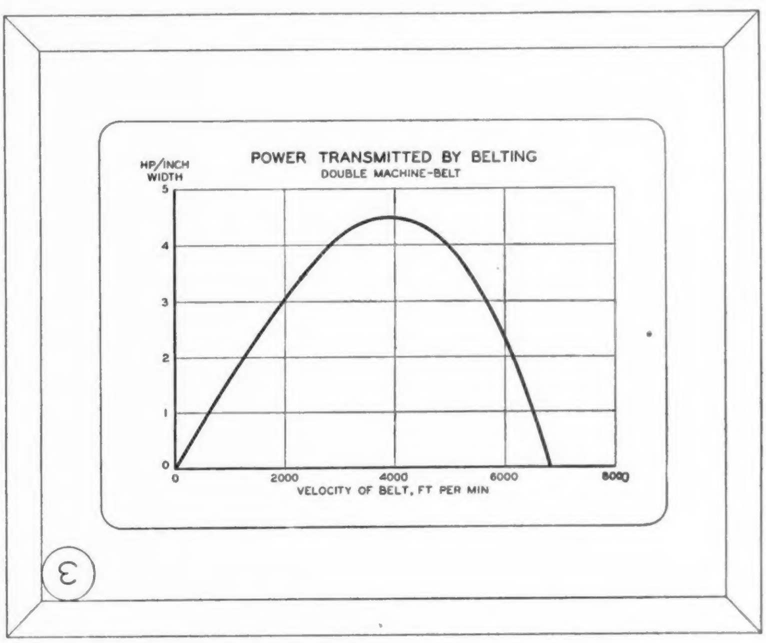
A new standard which will be a boon to those who have had to sit through many hours of lectures and papers illustrated with poor and even illegible lantern slides has just been approved by the American Standards Association in the form of an American Recommended Practice for Engineering and Scientific Charts for Lantern Slides (Z15.1-1932).

The standard, which provides rules for widths of the presentation of the data concerned in a systematic way by means of charts suitable for use as lantern slides when reduced to one-third of their original dimensions. With slight modifications as to line widths the recommendations usually are also applicable to charts that are prepared for use both as lantern slides and as illustrations for publication.

The new standard gives rules for the essential lines, lettering, and symbols designed to assure a maximum of legibility, was developed by a special sub-group of subcommittee 4 on Engineering and Scientific Graphs, of the Sectional Committee on Standards for Graphic Presentation (Z15), sponsored by the American Society of Mechanical Engineers. Walter A. Shewhart, special engineer, Bell Telephone Laboratories, New York, is chairman of this subcommittee; and Harold F. Dodge, Inspection Engineering Department, Bell Telephone Laboratories, is chairman of the sub-group.

In developing the standard, the sub-group directed its attention chiefly to the most common variety of engineering and scientific charts; namely, line charts which show the relationship between two variable quantities. The purpose of the recommendations is set-up of the charts; it further specifies types and sizes of lettering, as well as different line widths, and sizes of four symbols commonly used in graphs—an open circle, a solid circle, a triangle, and a square. The accompanying illustration shows an example of a chart reduced to lantern-slide size, the scale being one-third of the original chart dimensions. The size of about 7 x 10 inches is suggested for the over-all dimension of lantern-slide charts. This rectangle can be used either vertically or horizontally according to which method presents the data most effectively.

The recommended sizes of lettering and widths of line for letters are based on ophthalmological data, actual tests, and an investigation of the conditions under which standard projection equipments are used. For example, the focal length of the projection




*A typical standard chart—lantern slide size*

was assumed to be 12 inches, and the farthest spectator was assumed to be at the same distance from the screen as the lantern.

An appendix—which does not form part of the standard but simply serves as useful information—gives a table of commercial lettering templates and lettering pens with which the charts may easily be produced in the manner recommended. The appendix also contains a list of references to publications dealing with graphic presentation.

The new standard is available from the American Standards Association at 50 cents per copy.

## Interchangeability in Early Automobiles

A remarkable demonstration of interchangeability of parts in the early days of the automobile industry was recalled in the May issue of the *SAE Journal* in connection with the death in March, 1932, of one of the pioneers in this field, Henry M. Leland. After recalling the fact that the Leland and Falconer plant developed a single-cylinder engine and an improved planetary transmission for the first Cadillac car, and that after a few years the Leland and Cadillac companies were merged, Mr. Leland becoming president, the *SAE Journal* said:

> "In the days of the 'one-lunger' Mr. Leland astonished the mechanical world with a demonstration of interchangeability that won for the Cadillac car the Dewar trophy, which was awarded annually in England for the most meritorious demonstration of the advancement of the automobile industry. Three cars were chosen at random from the warehouse of the Cadillac agency in London, the cars were taken to Brooklands track and completely dismantled and the parts were placed in one conglomerate heap. Duplicates from the stock of spares were substituted for 89 parts in the pile; then three complete sets of parts were taken from the main heap without regard to the cars from which they were originally taken, and three 'new' cars were assembled. The only tools allowed were wrenches and screw-drivers; no files or emery cloth. After being assembled, all of the cars were started with a few turns of the crank and were driven several hundred miles on the track."

This demonstration took place as far back as 1908. Incidentally, Mr. Leland had the probably unique record of having manufactured rifles for the Civil War, and airplane engines for the World War.

## German Standard Colors for Airplane Equipment

National standard colors for the identification of the operating parts of airplane equipment (DIN L43) are being used with great satisfaction by the entire German airplane industry, according to a letter received from the Standards Committee on Aeronautics, working under the procedure of the German national standardizing body (Deutscher Normenausschuss). The standard colors are an important safety device because of the great number of pilots who frequently change planes, so that familiarity with the location of controls and equipment is important. The standards, which are also being accepted by other European countries, are as follows:

| *Color* | *To be used for handles, handwheels, etc., of* |
|---|---|
| Red | Fire extinguishers, fire alarms, short-circuit switches |
| Green | Temperature regulator for cooling water (cooler valves) |
| Yellow | Gas levers (throttles) |
| Brown | Temperature regulator for lubricating oil (coolers) |
| Black | Ignition levers (change of ignition) |

### Standard Methods for Screen Testing of Ores Published

The American Recommended Practice for Methods for Screen Testing of Ores (Hand Method), approved by the American Standards Association in July, 1932, has been published by the American Institute of Mining and Metallurgical Engineers, sponsor for the project. The standard may be purchased at 25 cents per copy from the A.I.M.E., 29 West 39 Street, New York, or from the American Standards Association. Announcement of the approval of the standard was published in the August, 1932, issue of INDUSTRIAL STANDARDIZATION.

### McGill Member of Committee on Paving Materials

W. J. McGill, Standard Oil Company of Indiana, Wood River Refinery, Wood River, Illinois, has succeeded S. A. Montgomery as representative of the American Petroleum Institute on the Sectional Committee on Road and Paving Materials (A37).

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